DWR OROVILLE FACILITIES RELICENSING PROJECT
(FERC Project No. 2100)

Study #1: Model Development Study Plan
December 12, 2001

1.0 INTRODUCTION/BACKGROUND

The FERC relicensing process requires a great deal of analysis both operational and environmental. Much of this analysis is based on "what if" questions such as What if we kept Oroville Reservoir Elevation higher until Labor Day? Or "What if build another powerplant at Hyatt? The answers to these and many other similar questions can not be found from analysis of existing data since the situations covered by the questions have never happened.

Computer models can produce estimates of the system response to changes in operations and or facilities that would results if the questions were actually implemented. These estimated operations can then be used to perform impact analysis to evaluate the operational, economic, or environmental impacts of the issue being addressed for the FERC relicensing process.

2.0 STUDY GOAL(S) AND OBJECTIVE(S)

The objective of this study is to develop and validate the necessary models, including collection of supporting data to simulate the physical attributes of Oroville Facilities operations to support studies involving changes to or impacts on flow, water levels, water supply, water temperature, and power generation. This study will not perform the actual simulations required for any analysis, it will simply provide the tools that are anticipated to be required to perform the actual analysis.

3.0 RELATIONSHIP OF THE STUDY PLAN TO RELICENSING PROJECT PROCESS/PURPOSE AND NEED FOR THE STUDY

Relationship of the Study Plan to Relicensing Project Process

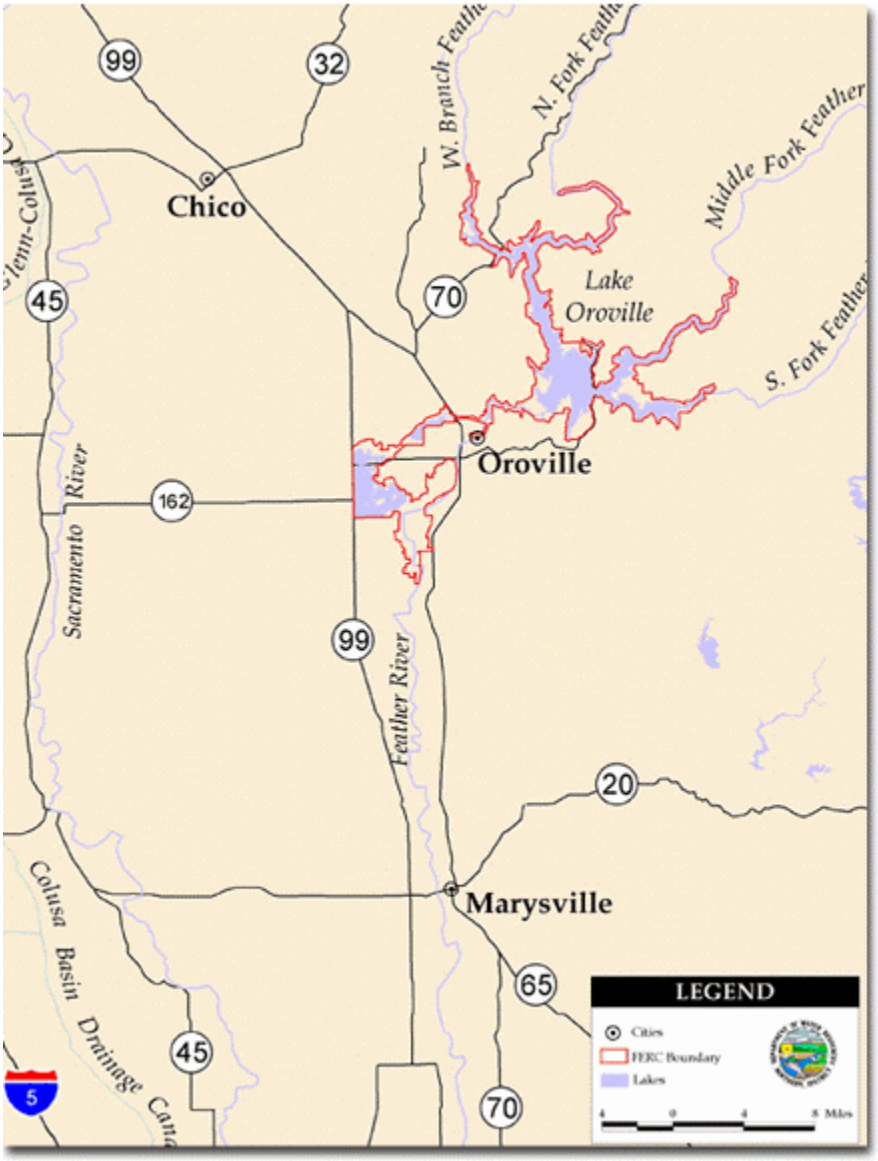
Computer simulations will be an integral part of many studies and analyses for the relicensing process. Additional computer studies will be part of other Work Groups' Study Plans addressing the myriad of stakeholder concerns and questions. The model development intends to ensure adequate computer modeling resources will be available to complete the needed studies. These studies will enhance information developed for FERC.

Purpose and Need for the Study

Adequate computer models to address the anticipated issues of concern in the relicensing process do not already exist. There are some existing models that may be useful as is or with some

enhancement work and there are other models that will need to be developed from scratch. These models also need to be integrated so that the results of one model, for example an operations model, can be used in another model, for example a temperature model, to produce results that can be used in an analysis, for example a fishery analysis. This study is will produce the integrated set of modeling tools required to address the anticipated issues of concern.

4.0 SCOPE – STUDY AREA



The physical scope of the computer modeling includes the Feather River basin from the upstream boundary of Lake Oroville to the confluence with the Sacramento River. This physical scope could expand into upstream areas if required for watershed analysis for inflows to the reservoir or to downstream areas if required for other work group purposes. The major work is expected to focus on the Oroville – Thermalito Complex and the Feather River downstream to the confluence with the Yuba River.

5.0 GENERAL APPROACH

This study plan is fairly general in approach because of the lack of firm requirements for modeling results from other work groups at this time. As the other work groups complete their study plans the requirements for modeling results will become better defined. This will be taken into account in the development of the individual modeling tools by modifying the individual model development plans as required.

This approach has been taken because analysis that will rely on computer simulation results can not begin until the models are fully developed and the actual modeling simulations required are completed. If model development does not begin before the results are required the entire relicensing process could be delayed. Because of this and because much of the model development work is general in nature this study plan can be written in more general terms than many other study plans. This approach will allow the model development efforts to begin sooner with the expectation that they will also be completed sooner than if we waited until all the requirements were known.

Detailed Methodology and Analysis Procedures

Task 1 – Define Modeling Scheme

Based on past FERC relicensing procedures, literature review and discussions with other Work Groups, it is anticipated that at least the following tools will be needed:

- Statewide Operations Simulation Model
- Oroville – Thermalito Complex Local Operations Simulation Model
- Oroville – Thermalito Complex and Feather River Temperature Model(s)
- Feather River Stage Discharge Model
- Feather River Sediment Transport Model
- In Stream Flow Methodology Model

These tools will be used in a predefined modeling scheme to perform the full range of modeling required to produce the outputs required for the analysis (Attachment A). Not all of these tools will be developed or used by the Engineering and Operations Workgroup but all must be taken into account to setup a modeling scheme that ensures consistency between the modeling efforts and the final analysis process. The modeling scheme will specify at a minimum:

- Major assumptions for modeling scheme
- Specific modeling tools that will be developed and used by the Engineering and Operations Workgroup
- Data translation – transfer protocols between modeling tools, including modeling tools developed and used by other groups (Attachment B)
- Procedures and process required to perform a full modeling effort for an alternative including required iterations between models,
- Database procedures and tools required for the model integration

Task 2 –Define Individual Model Development Plans

The specific models currently anticipated to be developed and/or used by the Engineering and Operations Work Group are:

- Statewide Operations Model (CALSIM II)
- Oroville – Thermalito Complex Local Operations Model
- Oroville Reservoir Temperature Model
- Thermalito Forebay-Afterbay Temperature Model
- Feather River Temperature Model
- Feather River Flow – Stage Model

Each of these models will be developed following a similar process that includes:

- Define outputs desired from the model and how they fit into the final analysis. This will require coordination with study plans from all other workgroups that may use the results of the specific model in their analysis.
- Review existing data for model development/calibration/verification/production use suitability
- Review existing models that could be used
- Review modeling tools that could be used to develop new models
- Select appropriate model or modeling tool
- Collect field data needed for model calibration/verification
- Complete model development/calibration/verification process
- Integrate completed model into overall modeling scheme from Task 1

A custom plan will be developed for each individual model based on the unique needs of the particular modeling tool selected and required outputs form the modeling.

Task 3 – Develop Individual Models

Using the development plan for each individual model complete the actual development work including and collection of data, calibration, and verification.

Task 4 – Fully Implement Modeling Scheme

This task will include development of all databases, data translation, and data transfer tools and procedures required to implement the modeling scheme developed in Task 1. These tools will be integrated with the appropriate models and tested to ensure that the entire system works as visualized.

Task 5 – Standardized Modeling Outputs

This task is to develop a process that will create a standardized set of outputs from any given model run for use in the analysis process. These outputs will be defined through close

coordination with the other workgroups and/or study plans that are using the information in their analysis (Attachment C).

The sub-tasks involved include:

- Define standard modeling outputs for analysis. These may include desired tables, graphics, statistical analysis as well as raw data for use in other modeling and/or analysis efforts. This will require coordination with the workgroups that expect modeling results for use in their analysis to ensure that the appropriate outputs are produced.
- Define model output requirements to produce the outputs
- Ensure that appropriate data from model outputs in is central database
- Develop procedure to produce the standardized set of outputs
- Complete documentation of each of the standardized modeling outputs including source of data, accuracy of data, appropriate usage of data, etc.

Task 6 – Other Modeling Outputs

This task includes the development of other model outputs that may be required for special purposes. These could include one time requests for modeling output in various formats. If the outputs are expected to be requested for most or all modeling simulations then they will be included in the Standardized Modeling Outputs under Task 5.

6.0 RESULTS AND PRODUCTS/DELIVERABLES

The result of this study will be a comprehensive suite of modeling tools available to answer or study the multitude of issues associated with the relicensing effort. The exact form and content of this suite will remain flexible throughout the duration of the relicensing process to allow reaction to different requirements that may happen over time.

Products/Deliverables

Models

This deliverable will include the individual models developed under this study plan. These are:

- Statewide Operations Model (CALSIM II)
- Oroville – Thermalito Complex Local Operations Model
- Oroville Reservoir Temperature Model
- Thermalito Forebay-Afterbay Temperature Model
- Feather River Temperature Model
- Feather River Flow – Stage Model

Modeling Environment

This will include all instructions, procedures, utilities, tools, and databases other than the individual models themselves, required to perform a complete simulation of any given alternative and to produce the standardized output products.

Standardized Output Products

This will be a standardized set of output products from the modeling that are generated from each alternative simulated. The products will include tables, graphics, statistical analysis, and raw data from model output as appropriate. These products will be given to other workgroups for use in their analysis.

7.0 STUDY PLAN COORDINATION AND IMPLEMENTATION STRATEGY

Coordination with Other Resource Areas/Studies

This task will require coordination with all model development study plans as they are all designed to produce a model to be used in the final modeling scheme. The task will also require coordination with all study plans that require output from the modeling to define the content and format of the output they want.

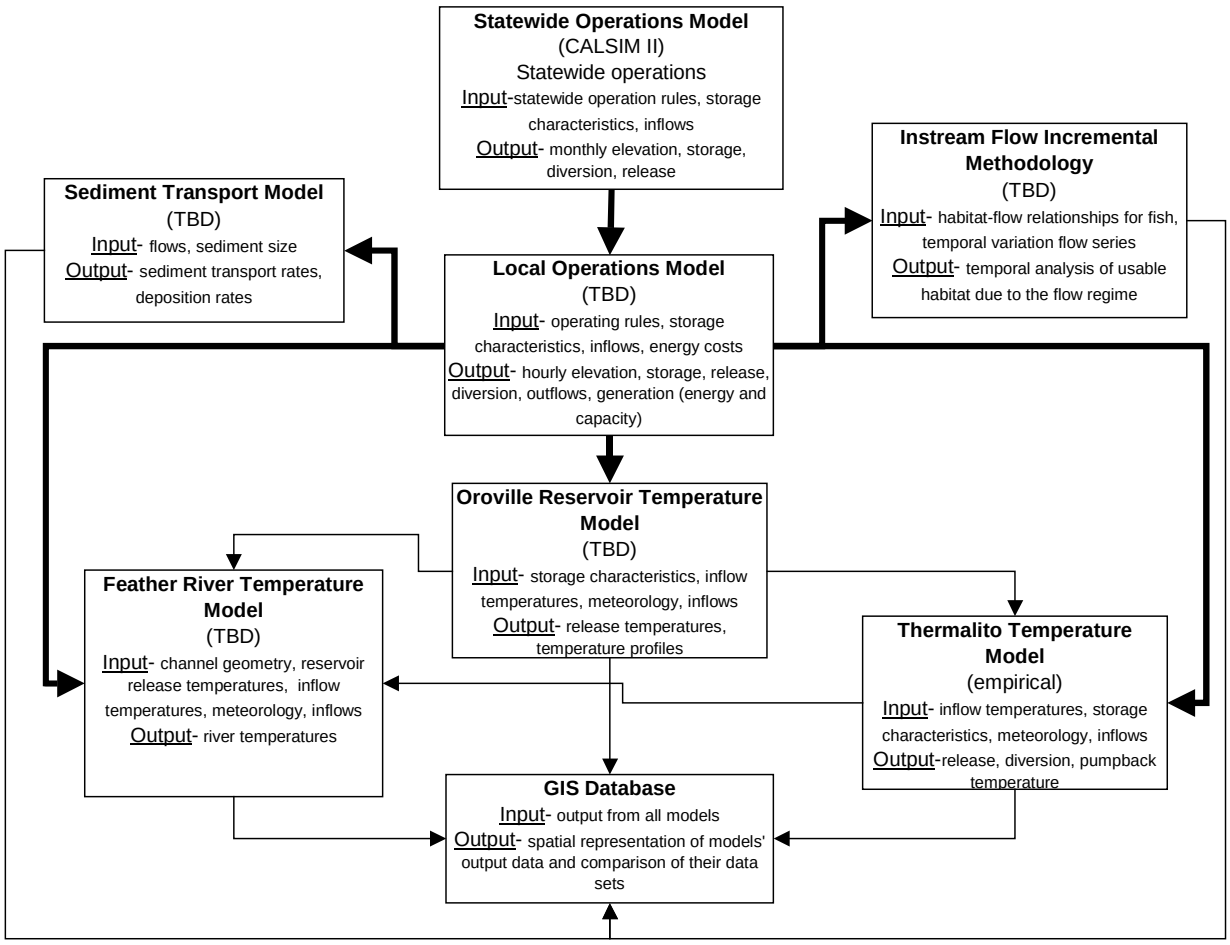
8.0 REFERENCES

ATTACHMENTS

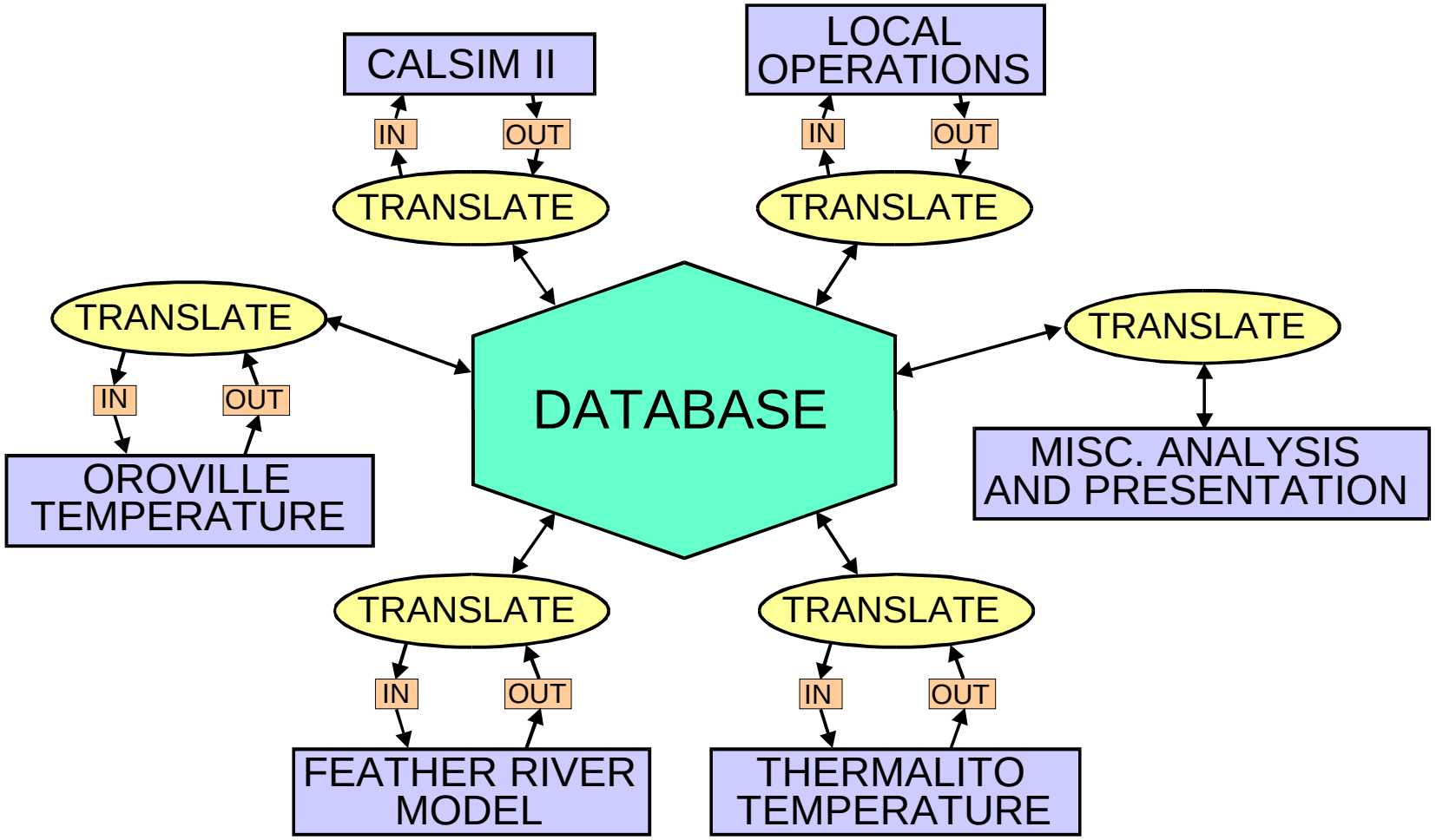
A. Modeling Flow Chart
B. Modeling Data Management Scheme
C. Examples of Standard Outputs

ATTACHMENT A

Modeling Studies Flow Chart

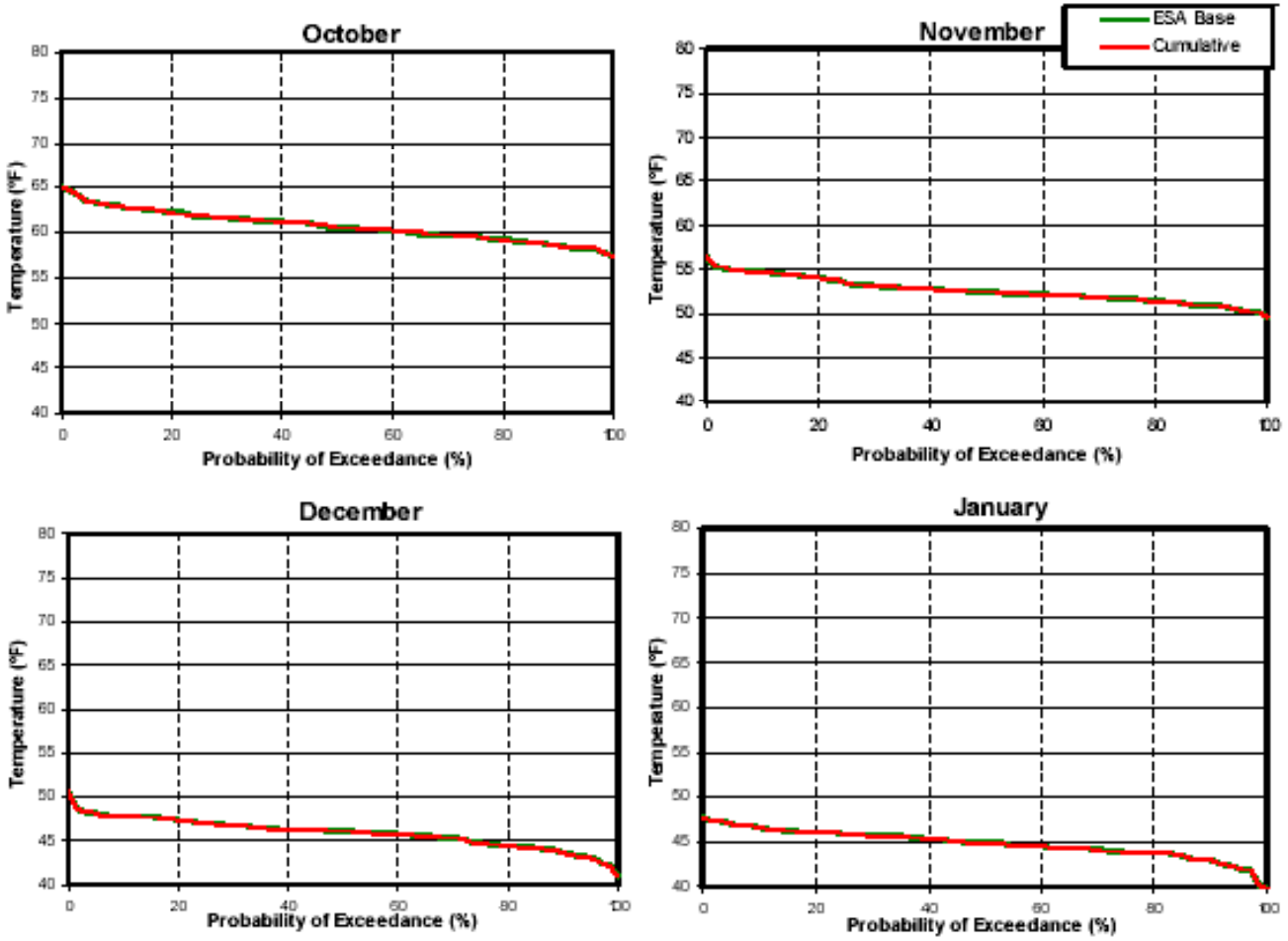


ATTACHMENT B

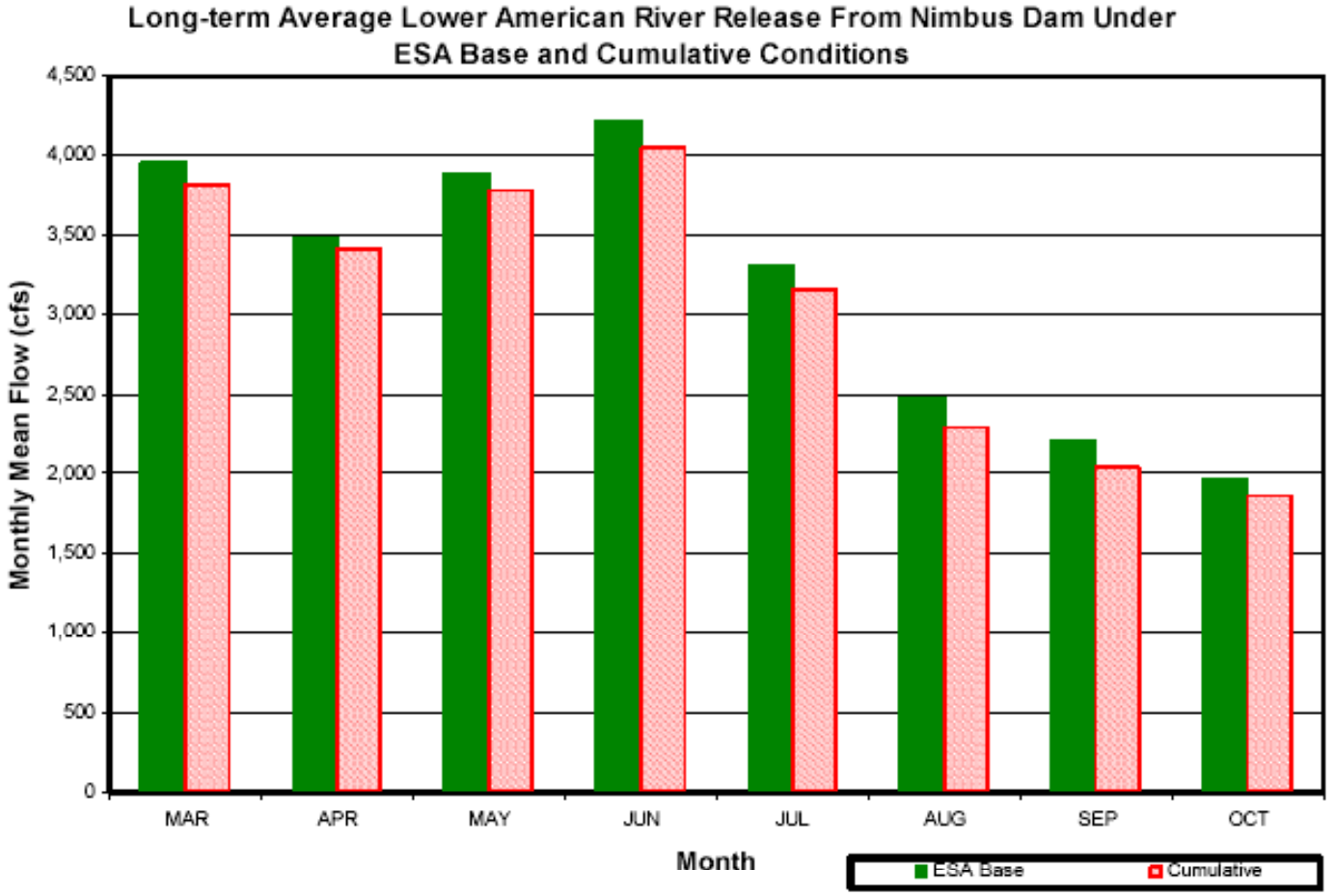

CALSIM II
IN
OUT
TRANSLATE
LOCAL OPERATIONS
IN
OUT
TRANSLATE
TRANSLATE
IN
OUT
OROVILLE TEMPERATURE
DATABASE
TRANSLATE
MISC. ANALYSIS AND PRESENTATION
TRANSLATE
IN
OUT
FEATHER RIVER MODEL
TRANSLATE
IN
OUT
THERMALITO TEMPERATURE

ATTACHMENT C

Temperature in the Sacramento River at Freeport Under ESA Base and Cumulative Conditions



Created: 7/26/2001 913 ARB Cumulative: Future Cumulative vs Baseline ESA 319



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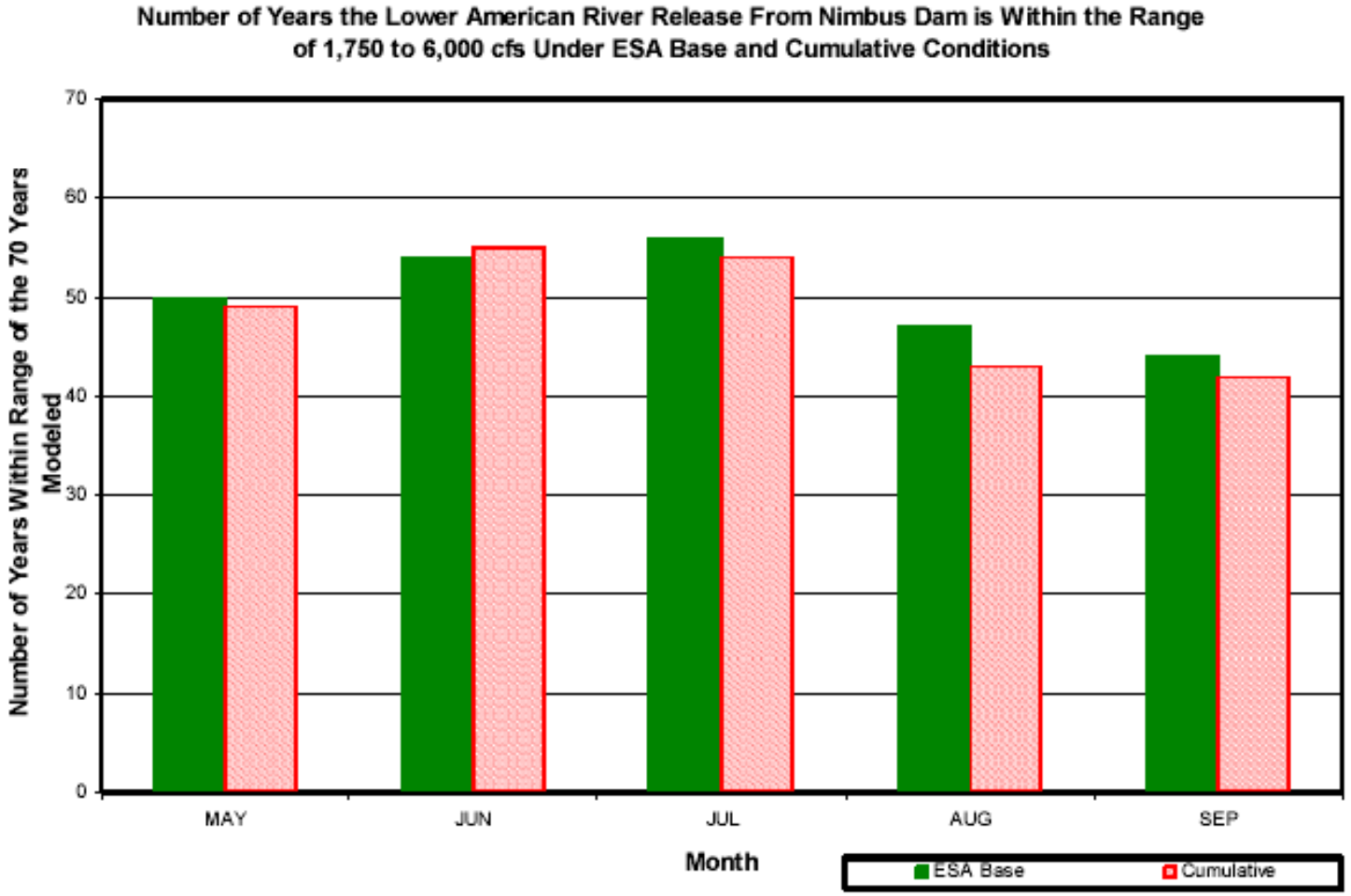
Flow Ranges Affecting Riparian Vegetation in the Lower American River Below Nimbus Dam Under ESA Base and Cumulative Conditions									
Month	Number of Years[1] Within Specified Ranges								
	3,000-4,500 cfs			< 1,765 cfs			< 2,000 cfs		
	ESA Base	Cumulative	Difference	ESA Base	Cumulative	Difference	ESA Base	Cumulative	Difference
Mar	21	20	-1	12	15	3	14	16	2
Apr	17	17	0	11	12	1	11	12	1
May	29	29	0	11	12	1	11	12	1
Jun	27	28	1	7	7	0	8	9	1
Jul	11	10	-1	13	15	2	17	16	-1
Aug	25	23	-2	25	28	3	28	32	4
Sep	16	15	-1	29	34	5	32	38	6
Oct	3	2	-1	28	31	3	28	31	3

[1] Based on 70 years modeled.


Number of Years the Lower American River Release From Nimbus Dam is Within the Range of 1,750 to 6,000 cfs Under ESA Base and Cumulative Conditions
Number of Years Within Range of the 70 Years Modeled
70
60
50
40
30
20
10
0
MAY
JUN
JUL
AUG
SEP
Month
ESA Base
Cumulative
Created: 7/26/2001
913 ARB Cumulative: Future Cumulative vs Baseline ESA
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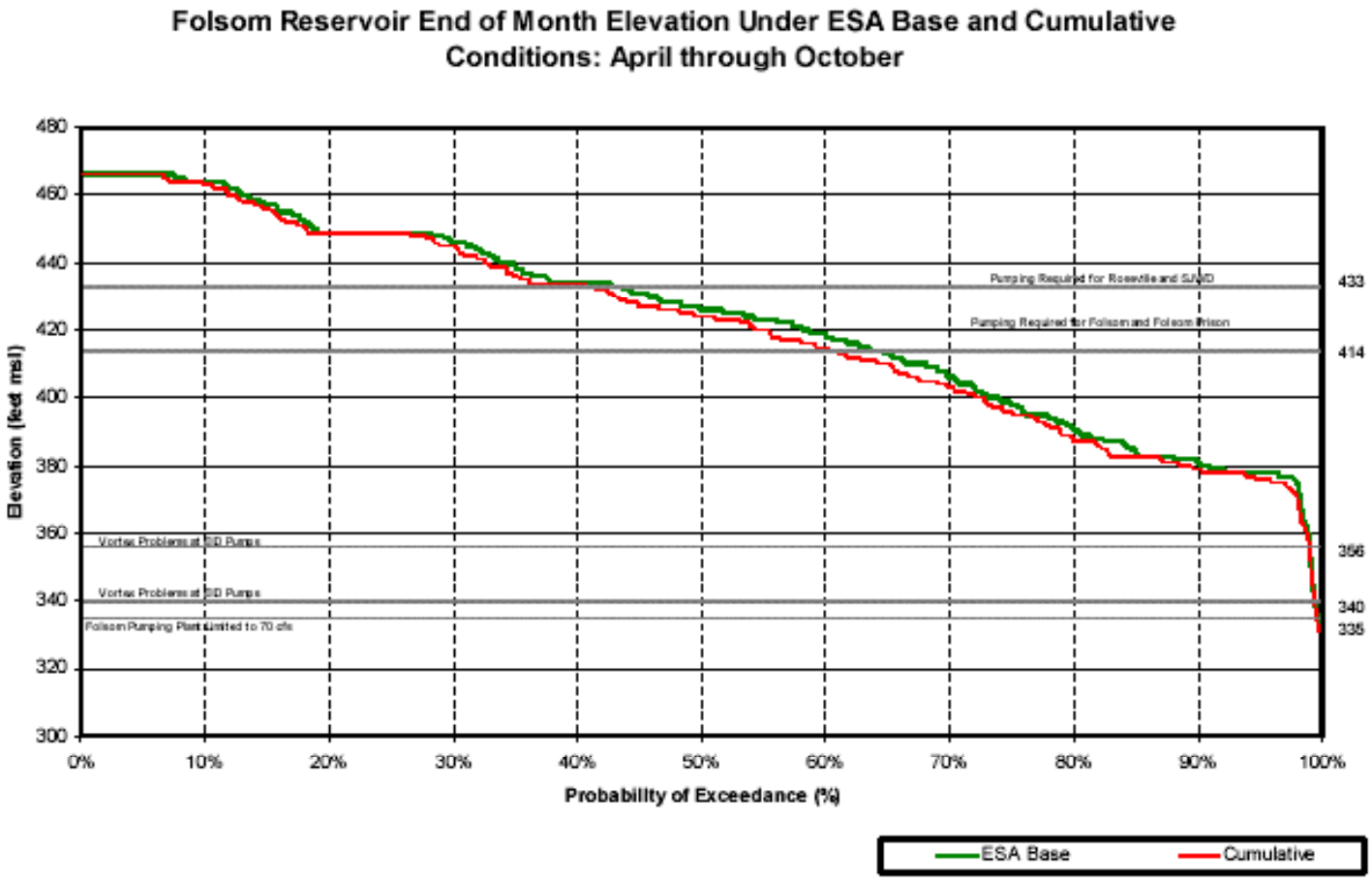
Folsom Reservoir End of Month Elevation Under ESA Base and Cumulative Conditions: April through October
Elevation (feet msl)
480
460
440
420
400
380
360
340
320
300
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Probability of Exceedance (%)
Pumping Required for Roseville and SJWD
Pumping Required for Folsom and Folsom Prison
Vortex Problems at SID Pumps
Vortex Problems at SID Pumps
Folsom Pumping Plant Limited to 70 cfs
433
414
356
340
335
ESA Base
Cumulative
Created: 7/26/2001
913 ARB Cumulative: Future Cumulative vs Baseline ESA

Long-term Average Shasta Reservoir End of Month Elevation Under ESA Base and Cumulative Conditions			
Month	Average Elevation* (feet msl)		
	ESA Base	Cumulative	Difference
Mar	1026	1025	-1
Apr	1037	1036	-1
May	1038	1037	-1
Jun	1027	1026	-1
Jul	1007	1006	-1
Aug	987	986	-1
Sep	980	979	-1
* Based on 70 years modeled.			

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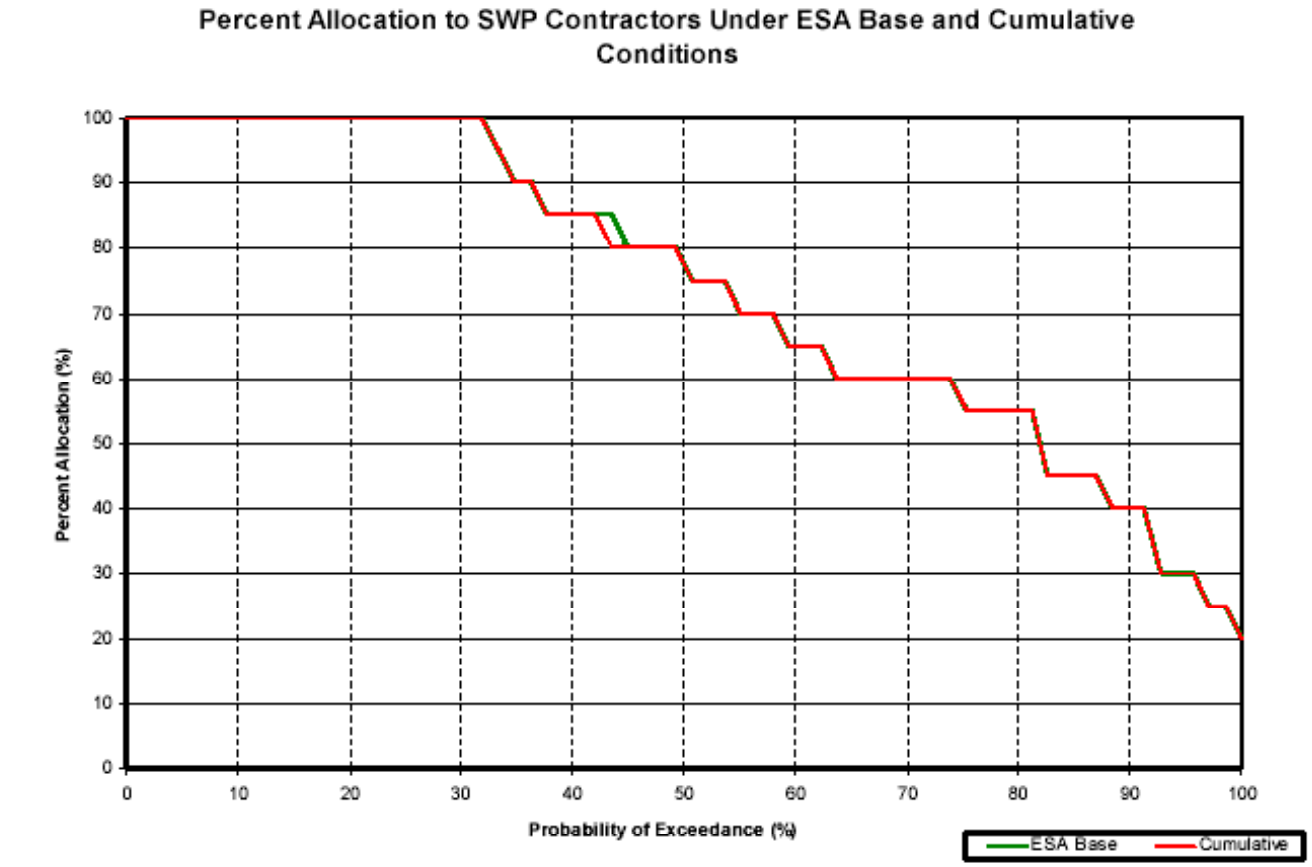
Percent Allocation to SWP Contractors Under ESA Base and Cumulative Conditions
Percent Allocation (%)
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Probability of Exceedance (%)
ESA Base
Cumulative
Created: 7/26/2001
913 ARB Cumulative: Future Cumulative vs Baseline ESA
40

Percent Allocation to SWP Contractors Under ESA Base and Cumulative Conditions[1]			
	ESA Base	Cumulative	Difference
Average	74%	74%	0%
Minimum	20%	20%	0%
Maximum	100%	100%	0%
Median	78%	78%	0%

[1] Based on the 70 years modeled.

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